Message

From: Boldrick, Lauren [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=9117A89A6C0644AC92FA156BB18BEEF8-BOLDRICK, L]
Sent: 5/11/2022 11:28:15 PM
To: Rice, Stephanie F [srice@blm.gov]
CC: Chu, Rebecca [Chu.Rebecca@epa.gov]; Pendergast, Kevin J [kpendergast@blm.gov]; Zachary Huff [zhuff@dowl.com]; Donna Robinson [drobinson@dowl.com]; Kristen Hansen [khansen@dowl.com]
Subject: RE: [EXTERNAL] Willow SEIS - Geology & Minerals Information Follow-Up

Hi Stephanie,

Here is the link to the BOEM NTL: https://www.boem.gov/sites/default/files/regulations/Notices-To-Lessees/2005/05-a01.pdf

You can see how the information was incorporated into the Liberty FEIS in Section 4.2.1: https://www.boem.gov/sites/default/files/about-boem/BOEM-Regions/Alaska-Region/Leasing-and-Plans/Plans/Vol-1-Liberty-FEIS.pdf

Now that the Alpine Incident Report is out, I'm mulling that over and working with our Underground Injection team on that. I saw that ConocoPhillips does have shallow hazards reports done for Willow – do you have those/can I have access to them? I am interested in the thaw bulb analysis for Willow as well.

As far as the mitigation measures below – I think #1 would be better framed as just general shallow hazards, perhaps formation integrity regarding the thaw bulb and permafrost to elaborate on the "*Project specific conditions would be evaluated during the site permitting process, and avoiding disturbance in areas with higher risks within the proposed sites would minimize hazards*" part. I did see in the Alpine report that the formation that caused issues at Alpine will be within the surface casing zone for the Willow wells – but spending some time on this topic seems worthwhile. I expect we'll have some more ideas around in this area soon to provide to you.

For #5, seismometers might be a helpful tool to monitor the permafrost degradation around the drill sites and contribute to the general Arctic understanding of permafrost degradation. Relatedly, I read this preliminary report that the Arctic will be facing increased seismicity due to climate change – I wonder what your geophysicists think about how this correlates to the large, natural earthquake that happened near Kaktovik in 2018. In my time working on the ANS, that's not a common thing to happen - so it would be nice for a geophysicist to mull that over a little.

Thanks!

From: Rice, Stephanie F <srice@blm.gov>
Sent: Friday, May 6, 2022 1:48 PM
To: Boldrick, Lauren <Boldrick.Lauren@epa.gov>
Cc: Chu, Rebecca <Chu.Rebecca@epa.gov>; Pendergast, Kevin J <kpendergast@blm.gov>; Zachary Huff <zhuff@dowl.com>; Donna Robinson <drobinson@dowl.com>; Kristen Hansen <khansen@dowl.com>
Subject: RE: [EXTERNAL] Willow SEIS - Geology & Minerals Information Follow-Up

Thanks Lauren, this is very helpful! I expect to get the SCC section back from the primary author next Friday and will send that along as soon as I can. Could you send me a copy of the BOEM Shallow Geologic Hazards document?

I've taken a look at the Bull Mountain EIS. Regarding updating the Geology section, I think the Willow MDP EIS accomplishes this analysis, it's just labeled differently. Impacts to geologic structures on the North Slope are described in the Soils, Permafrost, and Gravel and Water Resources sections (most of the topics covered in the geology section, like landslides and earthquakes, aren't relevant on the North Slope). If there's a specific geologic hazard that developing

Willow could impact or that could impact Willow that you don't think is covered in the EIS, please let us know. As far as I'm aware, induced seismicity from hydraulic fracturing is not an issue of concern on the North Slope.

Regarding the minerals section, the NPR-A has special laws related to mineral entry, so oil and gas development (covered in Cumulative Effects) and gravel (covered in soils, permafrost, and gravel) are the only relevant sections there.

I agree that additional mitigation measures could be necessary as we learn more about the causes of the gas leak at Alpine. I'll touch base with our petroleum engineering staff on your suggested measures below and let you know if we think of any others.

Stephanie Rice
Natural Resources Specialist
BLM Alaska State Office
Phone: 907 271 3202

From: Boldrick, Lauren <Boldrick.Lauren@epa.gov>
Sent: Tuesday, May 3, 2022 2:07 PM
To: Rice, Stephanie F <srice@blm.gov>
Cc: Chu, Rebecca <Chu.Rebecca@epa.gov>
Subject: [EXTERNAL] Willow SEIS - Geology & Minerals Information Follow-Up

Hi Stephanie,

Per our meeting on Friday, I looked at BLM's ePlanning site for other Master Development Plans/project specific EISs for oil and gas projects that have been completed in the last 15 years. In most of them, there is typically a Geology & Minerals section. It's pretty similar to the content I suggested in the PDESIS comments, and think it would support the public's understanding of the resources extracted/impacted by the project. One of the EISs contained some appropriate mitigation measures that I think would help the SDEIS be responsive to the Alpine incident.

Here's an example of the subjects covered:

Geology
- Structural Geology
- Surficial Geology
- Bedrock Geology
- Geologic Hazards
    - Earthquakes & Active Faults
    - Induced Seismicity
    - Landslides
    - Erosion
    - Floods

Minerals
- Fluid Leasable Minerals (oil, gas, and geothermal resources)
- Solid Leasable Minerals

- Locatable Minerals
- Salable Minerals

At this time, I'm taking some educated guesses about the Alpine incident and think these mitigations from the Bull Mountain Unit MDP EIS are worth modifying so they will apply to Willow/Alaska:

Mitigation 1—Avoidance of Areas with Geologic Hazards. The most effective mitigation to reduce effects of slope failure is to avoid areas with higher risks. Project specific conditions would be evaluated during the site permitting process, and avoiding disturbance in areas with higher risks within the proposed sites would minimize hazards.

Mitigation 4—Monitoring and Maintenance of Acceptable Injection Pressure. Monitoring of deep well injection pressures and of changes in the transmissivity (a measure of how much fluid can flow horizontally through an aquifer) during injection, can provide a means of determining whether deep injection pressures are causing fracturing of the reservoir rock and injection rates and pressures can adjusted to reduce the potential for these effects.

Mitigation 5—Monitoring of Seismicity. Monitoring of seismic activity with sensitive seismometers could be implemented as a follow-up measure to Mitigation 1, to determine whether earthquakes are triggered at the depth of injection, since this would provide additional evidence as to whether the reservoir rock was being fractured by injection pressures within the targeted injection zone. Because the state regulates injection wells, both of these mitigation measures would fall under the State of Colorado's jurisdiction. If adopted by SGI or the BLM, SGI would follow all state mandates, regulations, and policies. The BLM could adopt these measures as COAs or could require them as design features on a submitted APD. Their application would provide additional monitoring mechanisms for the possibility of injection well-induced seismicity.

To support these mitigation measures, the Bull Mountain MDP EIS discusses (for each alternative) the geologic hazards, existing seismic hazards, the potential for triggering earthquakes during deep well injection, the potential for inducing earthquakes by well stimulation (hydraulic fracturing), the potential for breaching geologic confining formations during hydraulic fracturing, and the potential for breaching geologic confining formations during deep well injection. I think regarding Alpine, it is important to capture this information in the Willow SEIS to promote safe drilling practices in later APD EAs.

As more information comes out about Alpine, we can discuss further, or I'll provide ideas to be more specific to the event. I also want to point out that BOEM has a Notice to Lessees that covers a good bit of information about shallow geological hazards, which may be a good reference too. I hope this gives you a bit more background to work with. Please let me know if you have any questions, and we can chat.

Thanks -

Lauren Boidrick, CPG
NEPA Reviewer
Policy and Environmental Review Branch
EPA Region 10

Submit NEPA environmental review documents to R10-NEPA@epa.gov